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Increasing the Acquisition Speed of a Multi-Channel Guided Wave System via Simultaneous Coded Excitations

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Many guided wave systems that are being evaluated for nondestructive evaluation or structural health monitoring utilize multiple transducers. Data are typically acquired by either exciting each transducer in turn or recording received signals simultaneously on the remaining transducers, or, for a multiplexed system, using a separate excitation for each transmit-receive transducer pair. For either case, it can be very slow to acquire data because of the multiple transmission cycles combined with a low repetition frequency and extensive signal averaging. This long acquisition time brings another disadvantage by increasing the risk of environmental changes occurring during the complete acquisition process. For example, applied loads and temperature could change over the several seconds that are frequently required to acquire data. To increase the acquisition speed, proposed here is a methodology whereby multiple transmitters are simultaneously triggered, and each transmitter is driven with a unique, coded excitation. The simultaneously transmitted waves are captured by one or more receivers, and their responses are processed by dispersive matched filtering [1,2] to separately extract the contribution from each transmitter. Results are shown for signals obtained from a spatially distributed array mounted on an aluminum plate. The separation performance for different excitations is evaluated in terms of both signal-to-noise ratio and imaging ability of the array.

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